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WALTER M. DICKIE, M.D., Director

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EDITOR

Why Epidemics[*]

By K. F. MEYER, Ph.D., M.D., Director Hooper Foundation for Medical Research.

The gratifying invitation of the Academic Senate to serve as Faculty Research Lecturer is traditionally interpreted as an opportunity for the university scholar to assemble and to correlate a series of facts and to bring them to the attention of his colleagues, students and friends of learning. Influenced by the swiftly moving trends of the times, it may perhaps be permissible to abandon the trail so faithfully followed by many. Instead of assessing the values of my own efforts in a narrow field of research, this unique and memorable occasion has been chosen to answer in part and to clarify if possible the everlasting question raised since my early boyhood: "What forces have created, have maintained and have suppressed the epidemic diseases of man and animals?" Such an inquiry interspersed with implications derived from personal observations may well serve as a general guide to fundamental matters of infectious disease and thus engender interest among a wider circle of listeners.

The Grecian sculptor, Sosius, carved with vivid sincerity the desperate Niobe protecting unsuccessfully her youngest and only surviving daughter against the poisonous darts of the infuriated gods. To his contemporaries, the sudden destruction of youth through epidemic disease appeared as an infliction imposed by some supernatural power or a dispensation of their gods. From the Bible and through folklore back into antiquity, mass mortalities were always considered to be different from the ordinary disease. Through the Middle Ages, with its prolonged and terrible epidemics, utter helplessness prevailed. The care of the sick, through the devoted administrations of the women and the servants of the Church, remained the only worthwhile task until the scientific concept of the contagium vivum, uninfluenced by the preconceived belief in the pestilential condition of air and soil, paved the way for the advance of progress. The searching light, now cast on bacteria and protozoa, revealed the part they played as causes of disease. The last 25 years of the past century thus created the bacteriologist, who is supposed to study the causes of the disease rather than the infectious process itself. On the other hand, his predecessor, the pathologist, analyzing the gross or microscopic changes, investigated the end result of disease in the cadaver. Modern experimental methods have brought these disciplines together but ultimately only in part can they solve the riddles surrounding those epidemic human diseases not transferable to small animals as, for example, lethargic encephalitis. It was reserved to a new field of science to assume the leadership. That is, epidemiology which studies the prime incitants of disease, tracing them to their lair and then interprets the reactions between the infecting agent and the infected body. Basically, to this correlating science is the task of integrating the field observations, the clinical records and the laboratory researches made on the individual in an endeavor to understand the mass phenomenon of the disease as manifested in an epidemic. The evolution of this modern methodology of investigative epidemic manifestations is particularly efficacious in an analysis of a new infection. Moreover, the training of those who ultimately serve as epidomiologists has, in part, adhered to the historic development of the science from clinical medicine to pathology, then to bacteriology and immunology and finally to the experimental method. Before we enter upon a discussion of the major questions proposed, it may not be amiss to illustrate this evolution on an example chosen from a series of events which took place a few years ago in California.

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[*] University of California Faculty Research Lecture, 1937.

Beginning the early part of August, 1930, scattered cases of a peculiar disease affecting the central nervous system of horses and mules began to attract the attention of livestock owners and veterinarians in the central part of the San Joaquin Valley. The malady began late in June or early in July and spread, so far as information was obtainable, radially over an increasing territory. Invariably the disease would rage in a localized section, then subside only to reappear in the same district. The malady was confined to the irrigated areas of the valley and more or less traveled along the water channels traversing the agricultural districts. Although, the preliminary diagnosis of equine botulism or forage poisoning was readily corrected by a careful clinical inspection of the diseased horses, the localization of the epidemic areas in the irrigated districts suggested a probable relationship. Notwithstanding that the disease appeared over a vast territory in a relatively short time, not all farms were affected and, strikingly, only one horse in ten showed symptoms, and rarely more than one or two animals of a group became affected. The latter observation and the fact that only horses and mules allowed on pasture were involved forcibly contradicted the theory of ingestion of poisonous or toxic food. The investigation began with a careful scrutiny of the anatomical findings in the central nervous system. The distribution and the character of the lesions, however, were of a stereotype character and merely permitted the conclusion that a nonbacterial or non-pyogenic incitant was responsible for the disease. It is a well-known fact that the brain and cord are so constructed that they are capable of reacting to injury in only a limited number of ways. Without a consideration of the symptoms and in particular inoculation experiments, a correct identification of the disease is impossible. At first, these tests progressed slowly since many experiments were required in order to find a susceptible animal other than the horse. With the discovery that the guinea pig would contract a disease remarkably similar to that seen in the horses, the next important inquiry had to deal with the distribution of the microscopically invisible disease agent within the body of the spontaneously and experimentally infected animals. During the febrile period of the disease, the incitant was found in the blood of the peripheral circulation. Furthermore, a chance observation revealed the important fact that the disease may be produced by the administration of the infectious material into or under the skin, thus the transmission from animal to animal could very well be accomplished by a bloodsucking insect. Although the pathway of infection of the virus under natural conditions has never been shown, Kelser and others demonstrated that the experimental transmission by several varieties of mosquitoes related to the yellow fever species was possible. Quite recently, the wood tick has been drawn into the arena of experimental transmission and is now suspected as a natural vector. Gradually the early observations in the field arranged themselves into a pattern which might be accounted for by the feeding habits of the bloodsucking insects coupled with the ripening period of the infective agent within the vector. The sharply limited seasonal character with the explosive swiftness of the epidemic during hot weather, its rapid to nearly complete disappearance with the onset of the cold and the lack of obvious connection between the cases as to contagion, water or food supply found its explanation. But in addition to the bite of an infected mosquito, another factor determined the diffusion of the disease over wide areas of both the San Joaquin and Sacramento Valleys in 1931 and 1932. Since a number of horses subjected to artificial infection proved to be resistant, the inference was drawn that the individual susceptibility was equally important in modeling the intriguing characteristics of the epidemic. In fact, it is suspected that the visible epidemic was accompanied by an invisible but immunizing wave which prevented the recurrence of the disease on the same ranch in subsequent years. So in logical sequence pathology, bacteriology, immunology and entomology contributed their share in the elucidation of an epidemic disease which at first had merely local but has since assumed national and international interest, since it has been observed in Argentine, Peru, Russia and Japan. Knowledge is still too fragmentary to permit more than a few instances where all phases of an epidemic be rationally explained.

Throughout the lapse of time and during the various periods of human culture, the problem of the infectious diseases has maintained its significant importance which will continue, perhaps with modifications in the future. More than half of the deaths and probably an even higher proportion of the sickness of mankind is caused by the infectious diseases. The enormous advances which are intimately connected with the names of Jenner, Pasteur, Lister, Koch, Roux and von Behring have merely altered the conditions quantitatively with respect to location and time. But the suppression of certain epidemic diseases has in no way influenced the general situation. It must be recognized that the human race is condemned to a continuous struggle which can never be permitted to relax without risking the loss of laboriously acquired successes.

The law of *etiological specificity,* which postulates that the morbid responses in an infectious disease are subordinated to a specific disease inciting agent, clearly necessitates a thorough appreciation of the diversity of measures required to meet the variable manifestation of disease. Since the days of Pasteur and Koch, our knowledge of this multiplicity has been greatly enhanced. With the improvement of the investigative methods, new nosologic entities of hitherto unknown infectious processes have made their appearance. To be sure, the number is steadily increasing and there is no reason to believe that an end has as yet been reached. In consequence, further dissipation of efforts both in the scientific and in the practical administration of public health will be unavoidable.

The discovery by Smith, Andrewes and Laidlaw within the past 3 years that a characteristic febrile disease could be induced in ferrets by the intranasal instillation of filtered nasal washings from a human case of epidemic influenza may well place the puzzling problem of this disease on a sounder foundation. There is hope that some effective method of prevention may in time reduce the frightfulness of this great killer of adult life. Whether traditional principles, such as immunization of the individual or disinfection with ultra-violet rays of the infectious droplets expelled by the diseased will be used depends on researches which are now in progress. Through the fundamental and startling discoveries by Stanley, Beard and Wyckoff, it is now possible to list protein molecules along with living organisms, such as bacteria, fungi and protozoa as infectious disease-producing agents. There is every expectation that when some of the supposedly virus diseases causing human ills are further studied, they will be found to be of the nature of a protein non-living "germ" or virus.

In what manner have the human race and the animal kingdom become subject to this multiform epidemization? What maintains its existence? Is there some hope that what nature has created again may again be destroyed? In other words, is it reasonable to expect that the prevailing epidemic infections may vanish without direct human interference?

The dawn of bacteriology was not interested in these questions. An elucidation of the nature of the prevailing infections promised results of great practical and theoretical significance. Since the expectations were richly rewarded, the trend of research assumed the form of an extreme and one-sided search for cause or causes. Once the foundations of the newly discovered field had been laid, the *concept of disposition,* temporarily neglected in favor of the exerting search for the disease agent, assumed its dominant role. As late as 1891 Rosenbach, a pupil of R. Koch, criticised the unilateral study of the mode of transmission of the individual human or animal infectious unit, and proposed the *realization of the epidemic as a natural mass or herd phenomenon.* Thus was brought to the surface the problem of the rise and fall of epidemics. Further, this newer idea supplied a sounder supposition for the development of rational control procedures.

(Continued in next issue)

The inventors of the alphabet could not have foreseen the odd uses to which their signs and symbols would some day be put: how a man might read to take his mind off a mortgage, to make a journey seem shorter, to kill ennui, to rest the mind after an emotional storm, or to lull himself to sleep at night. If you would develop powers, read not often merely to pass the time, for listless reading breeds a poor memory.

MORBIDITY

Complete Reports for Following Diseases for Week Ending May 29, 1937

Chickenpox

1280 cases: Alameda County 2, Alameda 24, Berkeley 49, Emeryville 9, Oakland 59, Piedmont 5, Chico 6, Contra Costa County 13, El Cerrito 5, Pittsburg 6, Fresno County 8, Fresno 9, Reedley 2, Sanger 11, Eureka 2, El Centro 4, Kern County 28, Bakersfield 1, Taft 2, Kings County 20, Los Angeles County 35, Alhambra 3, Beverly Hills 10, Burbank 3, Compton 3 Culver City 7, Glendale 10, Hermosa 9, Huntington Park 1, Inglewood 7, Long Beach 29, Los Angeles 190, Monrovia 1, Pasadena 34, Redondo 1, San Gabriel 3, Santa Monica 8, Sierra Madre 2, Whittier 2, Torrance 2, Lynwood 4, Hawthorne 1, South Gate 3, Maywood 3, Bell 1, Marin County 3, Mill Valley 2, Soledad 1, Nevada City 38, Orange County 26, Anaheim 10, Orange 7, Santa Ana 15, Laguna Beach 1, Placentia 2, Tustin 1, Roseville 13, Riverside County 14, Corona 3, Riverside 3, Sacramento 42, Ontario 1, Redlands 2, San Diego County 6, La Mesa 3, National City 18, San Diego 75, San Francisco 98, Lodi 1, Stockton 6, San Luis Obispo County 1, San Luis Obispo 2, San Mateo County 5, Burlingame 2, Daly City 1, Santa Barbara County 19, Santa Barbara 4, Santa Clara County 28, Mountain View 3, Palo Alto 6, San Jose 6, Sunnyvale 2, Santa

Cruz County 1, Benicia 1, Sonoma County 3, Patterson 90, Tulare 48, Lindsay 2, Ventura County 14, Ojai 5, Yolo County 6, Davis 3.

Diphtheria

47 cases: Alameda County 1, Oakland 6, Butte County 1, Fresno County 1, Fresno 1, Los Angeles County 4, Los Angeles 11, Santa Monica 1, Monterey County 1, Orange County 3, Placer County 1, San Francisco 2, Stockton 1, Santa Barbara 4, Santa Clara County 1, Mountain View 1, Palo Alto 1, San Jose 2, Watsonville 1, Yuba County 2, Marysville 1.

German Measles

44 cases: Berkeley 7, Emeryville 1, Oakland 1, Eureka 1, Westmoreland 1, Inyo County 1, Kern County 2, Los Angeles County 7, Alhambra 1, El Monte 1, Long Beach 1, Los Angeles 6, Pasadena 1, South Pasadena 2, Whittier 1, Tustin 1, San Diego County 1, San Diego 1, San Francisco 3, Stockton 1, Daly City 1, Ventura County 2.

Influenza

62 cases: Oakland 2, Kern County 18, Kings County 2, Los Angeles County 4, Long Beach 1, Los Angeles 15, Pomona 1, Whittier 1, Nevada City 3, Corona 1, San Francisco 2, Menlo Park 2, Santa Maria 1, Tulare County 3, Lindsay 6.

Malaria

4 cases: Orland 1, Monterey County 1, Stockton 1, California 1.*

Measles

364 cases: Berkeley 3, Oakland 12, Piedmont 2, Butte County 1, Fresno 2, El Centro 12, Westmoreland 4, Kern County 3, Kings County 3, Los Angeles County 4, Claremont 2, Glendale 12, Inglewood 2, Long Beach 17, Los Angeles 37, Lynwood 1, South Gate 1, Marin County 1, Mariposa County 9, Nevada City 6, Orange County 6, Anaheim 1, Brea 1, Newport Beach 5, Placer County 11, Auburn 8, Colfax 3, Lincoln 23, Riverside County 13, Corona 47, Sacramento County 2, Sacramento 25, San Diego County 10, Coronado 1, El Cajon 8, National City 1, San Diego 4, San Francisco 17, Sierra County 5, Vallejo 1, Modesto 1, Sutter County 2, Yuba City 3, Tulare County 5, Lindsay 1, Yolo County 3, Winters 1, Yuba County 19, Marysville 3.

Mumps

704 cases: Alameda 6, Berkeley 30, Emeryville 2, Oakland 24, Piedmont 1, Butte County 2, Contra Costa County 3, Pittsburg 9, Fresno County 6, Fresno 10, Eureka 11, Imperial County 1, El Centro 5, Inyo County 1, Bishop 14, Kern County 7, Kings County 17, Los Angeles County 44, Alhambra 10, Arcadia 3, Beverly Hills 2, Compton 13, Glendale 2, Huntington Park 3, Inglewood 3, La Verne 8, Long Beach 15, Los Angeles 45, Manhattan Beach 2, Pasadena 15, Pomona 1, San Gabriel 6, Santa Monica 5, Lynwood 5, Hawthorne 1, South Gate 4, Bell 1, Madera County 2, Madera 1, San Rafael 1, King City 2, Orange County 9, Anaheim 1, Fullerton 9, Santa Ana 14, Placentia 3, Tustin 1, Roseville 1, Plumas County 3, Riverside County 4, Riverside 17, Sacramento 8, Redlands 1, San Bernardino 2, San Diego County 15, Chula Vista 2, Coronado 2, El Cajon 2, National City 4, San Diego 68, San Francisco 97, San Joaquin County 1, San Luis Obispo 1, San Mateo County 8, Daly City 6, Santa Barbara County 3, Lompoc 10, Santa Barbara 7, Santa Clara County 4, Mountain View 3, Palo Alto 1, San Jose 16, Sunnyvale 1, Sonoma County 11, Trinity County 3, Tulare County 2, Lindsay 3, Ventura County 17, Santa Paula 1.

Pneumonia (Lobar)

54 cases: San Leandro 1, Butte County 1, Los Angeles County 9, Alhambra 1, Azusa 2, Long Beach 2, Los Angeles 21, Pasadena 1, San Gabriel 1, South Pasadena 1, Anaheim 1, Riverside 1, Sacramento 2, San Diego 1, San Francisco 8, Modesto 1.

Scarlet Fever

228 cases: Berkeley 6, Hayward 1, Oakland 9, Butte County 3, Chico 1, Colusa County 1, Contra Costa County 5, El Cerrito 1, Martinez 2, Pinole 1, Fresno County 7, Fresno 3, Arcata 2, Eureka 2, Kern County 18, Bakersfield 1, Los Angeles County 18, Alhambra 1, Beverly Hills 1, Compton 1, Glendale 2, Long Beach 1, Los Angeles 43, Monrovia 1, Pasadena 2, Redondo 1, San Fernando 1, San Gabriel 1, Santa Monica 1, Maywood 1, Bell 1, Mariposa County 1, Napa County 1, Napa 1, Anaheim 2, Santa Ana 2, Roseville 1, Riverside County 4, Corona 2, Riverside 3, Isleton 1, Redlands 1, National City 2, San Diego 1, San Francisco 22, San Joaquin County 7, Stockton 5, Paso Robles 1, San Mateo County 2, Daly City 1, Santa Barbara County 2, Lompoc 1, Santa Clara County 2, Mountain View 1, Palo Alto 1, San Jose 4, Sunnyvale 1, Santa Cruz County 1, Benicia 2, Vallejo 1, Sonoma County 1, Sutter County 2, Tehama County 1, Tulare County 6, Lindsay 1, Visalia 2.

Smallpox

27 cases: Los Angeles 1, Riverside County 12, San Diego County 1, San Diego 13.

Typhoid Fever

5 cases: Alameda 1, Imperial County 2, Sacramento County 2.

Whooping Cough

617 cases: Alameda County 3, Alameda 4, Berkeley 2, Emeryville 2, Oakland 7, Chico 1, Colusa County 12, Contra Costa County 15, Fresno County 13, Fresno 10, Selma 3, Orland 7, Imperial County 14, El Centro 3, Kern County 15, Kings County 9, Los Angeles County 52, Alhambra 4, Arcadia 1, Avalon 6, Azusa 1, Beverly Hills 1, Burbank 2, Claremont 2, Culver City 2, El Monte 2, El Segundo 1, Glendale 2, Hermosa 1, Huntington Park 5, Inglewood 1, Long Beach 12, Los Angeles 136, Manhattan 1, Monrovia 2, Pasadena 12, Pomona 8, San Gabriel 1, San Marino 1, Santa Monica 4, Whittier 5, Torrance 1, Madera County 3, Marin County 12, Mill Valley 2, Nevada City 1, Orange County 6, Fullerton 3, Santa Ana 1, Placer County 1, Lincoln 1, Plumas County 4, Riverside County 4, Corona 3, Riverside 5, Sacramento 12, San Bernardino 1, San Diego County 18, San Diego 9, San Francisco 33, San Joaquin County 27, Lodi 2, Stockton 8, San Luis Obispo 1, Santa Barbara County 3, Santa Barbara 3, San Jose 1, Sonoma County 8, Tehama County 2, Red Bluff 6, Tulare County 16. Lindsay 4, Ventura County 3, Santa Paula 1, Yolo County 3, Woodland 7, Yuba County 16.

Meningitis (Epidemic)

9 cases: Humboldt County 1, Kern County 1, Los Angeles County 1, Glendale 1, Los Angeles 3, Sacramento County 1, Redwood City 1.

Dysentery (Amoebic)

5 cases: Long Beach 2, Marin County 1, National City 1, San Joaquin County 1.

Dysentery (Bacillary)

8 cases: Los Angeles.

Poliomyelitis

5 cases: El Centro 1, Los Angeles 3, Torrance 1.

Pellagra

6 cases: Oakland 4, Los Angeles County 1, Madera County 1.

Tetanus

2 cases: Los Angeles.

Trachoma

2 cases: Los Angeles 1, San Francisco 1.

Paratyphoid Fever

One case: San Diego.

Rocky Mountain Spotted Fever

One case: Lassen County.

Typhus Fever

One case: Los Angeles.

Botulism

One case: Long Beach.

Jaundice (Epidemic)

One case: Stanislaus County.

Food Poisoning

68 cases: Butte County 3, Fresno County 3, Los Angeles 28, Madera County 3, Madera 12, Chowchilla 2, San Francisco 5, Stockton 2, San Mateo County 1, Santa Clara County 9.

Undulant Fever

3 cases: Los Angeles 1, Chino 1, Sonoma County 1.

Septic Sore Throat (Epidemic)

2 cases: Lake County 1, Glendale 1.

Rabies (Animal)

62 cases: Fresno 1, Imperial County 1, Los Angeles County 20, Arcadia 1, El Segundo 1, Glendale 3, Hermosa 1, Inglewood 1, Long Beach 1, Los Angeles 20, Manhattan 2, Montebello 1, Redondo 1, San Fernando 1, Whittier 1, Torrance 1, South Gate 2, Madera County 1, Monterey County 1, San Diego 1.

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* Cases charged to "California" represent patients ill before entering the state or those who contracted their illness traveling about the State throughout the incubation period of the disease. These cases are not chargeable to any one locality.

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